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UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION

METAL AND NONMETAL MINE SAFETY AND HEALTH

REPORT OF INVESTIGATION

Surface Metal Mine
(Taconite)

Fatal Machinery Accident
November 6, 2005

Empire Mine
Empire Iron Mining Partnership
Palmer, Marquette County, Michigan
Mine I.D. No. 20-01012

Investigators

William G. Dethloff III
Mine Safety and Health Inspector

Robert W. Leppanen
Mine Safety and Health inspector

Dale P. Ingold, PE
General Engineer

Originating Office
Mine Safety and Health Administration
North Central District
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Steven M. Richetta, District Manager

OVERVIEW

Chad M. Weston, assistant plant operator, age 28, was fatally injured on November 6, 2005, when he was pinned between a cooler frame and a cooler pallet dump arm. The victim and a co-worker were attempting to free a stuck cooler pallet.

The accident occurred because the operating procedures and controls used to release the stuck cooler pallet were inadequate. The existing procedures did not ensure that persons were protected from being struck by the sudden movement of the pallet dump arm while performing this task.

GENERAL INFORMATION

Empire Mine, a surface taconite ore operation, was operated by The Cleveland-Cliffs Iron Company. The mine, owned by Empire Iron Mining Partnership, was located in Palmer, Marquette County, Michigan. The principal operating official was Clifford T. Smith, vice president and general manager. The mine normally operated three, 8-hour shifts, seven days a week. Total employment was 570 persons.

Taconite ore, mined from multiple benches, was drilled, blasted, and loaded into production trucks by shovels and loaders. The material was transported to the crusher where it was crushed to size. The ore was further processed in the concentrator and sent to the pellet plant where it was pelletized, dried on a grate, heated in a kiln, and cooled. The finished pellets were transported by rail to ore docks and shipped to steel manufacturing companies.

INVESTIGATION OF THE ACCIDENT

MSHA was notified of the accident at 12:50 p.m. on November 6, 2005, by a telephone call from Leonard R. Parker, safety and environmental manager, to Gerald D. Holeman, assistant district manager. An investigation was started the same day. An order was issued under the provisions of Section 103(k) of the Mine Act to ensure the safety of the miners.

MSHA's accident investigation team traveled to the mine, conducted a physical inspection of the accident scene, interviewed employees, and reviewed documents and work procedures relevant to the accident. MSHA conducted the investigation with the assistance of mine management, employees, and the miners' representative.

DESCRIPTION OF THE ACCIDENT

On the day of the accident, Chad M. Weston (victim) reported to work at 7:00 a.m., his scheduled starting time. About 11:45 a.m., Patrick Stahl, control room operator, received a stuck cooler pallet alarm for unit 4. Stahl told Weston to check out the stuck cooler pallet on unit 4. Weston left the control room and met Jeremy Ring, co-assistant plant operator, who went with him to the cooler dump point.

Stahl switched the unit 4 cooler control from automatic to manual in the control room. He tried to start the cooler by giving the cooler drive start commands 22 times in a 3 minute and 28 second time frame.

During this time frame, Weston tried to position a port-a-power cylinder jack at the middle of the arm, but it would not fit. Weston handed the port-a-power to Ring and told him to place the port-a-power at the end of the dump arm.

Before Ring could position the port-a-power under the dump arm, the cooler pallet suddenly broke free, causing the dump arm to move. Ring heard Weston yell and saw him pinned between the cooler pallet dump arm and the cooler structure. Ring called for help over the 2-way radio. Michael P. Filizetti, pellet plant coordinator, heard the call for help and went to the unit 4 cooler area.

When Filizetti arrived, he instructed Stahl to call for emergency medical assistance. Filizetti was unable to release Weston with the port-a-power so he used a come-along to pull the cooler dump arm to free the victim. Company first responders attempted cardio-pulmonary resuscitation (CPR) until emergency medical personnel arrived. Weston was transported to a local hospital where he was pronounced dead by the medical examiner. The cause of death was attributed to blunt trauma.

DISCUSSION

Location of the Accident

The accident occurred at the unit 4 cooler pallet dump zone in the pellet plant. The flooring, constructed of steel grating, was dry and clear of any spillage. Lighting in this area was adequate.

Unit 4 Cooler

The unit 4 cooler was manufactured by Allis-Chalmers and was used to cool iron ore pellets. The cooler was ring-shaped with an enclosed area approximately 11 feet wide, with an approximate 45 foot inner diameter, and an approximate 67 foot outer diameter.

The moving floor frame of the enclosed area had 30 segments, referred to as pallets, attached to it. Each end of a pallet shaft was connected to the floor frame by rotational connections. This arrangement allowed the pallets to rotate around their shafts and dump their loads. Pallets were kept level in the cooler by the dump arm attached to the end of the pallet shaft outside of the enclosure in the cooler's inner diameter. The opposite end of the dump arms had a wheel (picture #1). The wheel would ride on a guide rail which governed the pallet position.

The distance between the cooler frame and the trip wheel was approximately 25 inches when in a stuck pallet position. The open area through which the trip wheel could travel when freed was approximately 2 square feet and was not

provided with a guard (attached sketch – Appendix C). The pallet shaft was eccentric with over 60 percent of the pallet and load weight to one side of the shaft. This arrangement caused the pallet to tip by gravity at the dump point under normal conditions (see picture #2). The speed of the floor was variable and was set depending on the characteristics of the pellets. At the time of the accident, the cooler reportedly completed one revolution in approximately 45 minutes.

A walkway was provided along the inner diameter of the cooler. The outside edge of the walkway had a solid handrail in place to prevent persons from contacting the slow moving dump arms and wheels. A pull cord was positioned around the cooler circumference and near the moving wheels to stop the cooler if pulled. At the location of the stuck cooler pallet tripper arm, an approximately 98-inch wide opening existed in the solid handrailing with two removable chains provided. The upper chain was 29-½ inches from the floor and the lower chain was 14-½ inches from the floor. These chains were permanently attached at one end and slipped onto a hook positioned at the opposite end (see picture #5). When these chains were removed, access was provided to free the stuck cooler pallet dump arm.

Cooler Pallet Tripper Arm

The cooler pallet tripper arm, or pallet trip, was referred to as the “sure dump”. This device activated when a pallet failed to dump. When this occurred, the wheel stayed down and rolled onto the cooler pallet tripper arm. This compressed a hydraulic cylinder, applying additional rotational force to dump the pallet. If the additional force didn’t activate the pallet to dump, the cooler continued to travel and the hydraulic cylinder collapsed until the tripper arm contacted the stuck pallet warning and stop limit switches (see picture #3).

Reportedly, if the pallet wasn’t dumped in approximately 5 minutes, the line would have to be shut down and the cooler cleaned because the hot pellets would fuse together. Information posted inside the hydraulic motivating system cabinet, the “sure dump” - accumulator, check valve, flow control valve, relief valve, and gauges, stated the accumulator and hydraulic pressure gauges should indicate 1350 pounds per square inch gauge (psig) of pressure (see picture #4).

At the time of the investigation, the hydraulic oil pressure gauge read approximately 200 psig. The nitrogen gas pressure gauge on the accumulator read approximately 1200 psig.

When measured at the center of its anchor points, the length of the extended hydraulic cylinder measured approximately 37 inches. The manufacturer’s specification for full extension was 41.81 inches.

The tripper arm was positioned at an approximate 35 degree angle to the horizontal at the time of the accident. The original tripper arm design specified a fully deployed position of 45 degrees.

When a load was placed against the tripper arm, hydraulic pressure would increase. Readings of approximately 1500 psig indicated the pressure relief valve was functional. The manufacturer's specified setting for the pressure relief valve was 1170 psig. The manufacturer's designed working pressure for the hydraulic cylinder was 1400 psig with a 3 to1 safety factor.

These differences did not result in a force being applied to the tripper arm that was less than originally designed.

Procedures for Stuck Cooler Pallet

When a stuck cooler pallet occurred, an alarm was sounded in the control room. The control room operator then contacted the assistant plant operator(s) assigned to the burner floor. The assistant plant operators first checked through the cooler dump doors to see if anything was on top of the pallet to prevent dumping. If nothing was found, the assistant plant operator would switch the selector, in the cooler control box located one floor above, from the remote position to the local position for over-riding control. During the investigation, this selector switch was found in the remote position. The assistant plant operators would go to the sure dump system one floor below. After determining hydraulic pressures on the gauges were correct, they would check the previous pallet to determine if it was preventing the subsequent stuck pallet from dumping.

A common procedure to free a stuck pallet was to use a port-a-power and apply force. The port-a-power's cylinder was placed under the wheel end of the dump arm wherever the jack head would fit and the cylinder was extended until the pallet was free (see picture #1). The job was typically performed by two people. One person positioned the cylinder below and to the right of the wheel (see picture #1) and the second person operating the port-a-power would stand to the right of the person setting the cylinder in place. As the port-a-power was positioned, the operator pressurized the cylinder enough to keep it in place. The person handling the port-a-power then moved away and the cylinder was raised until the pallet was freed. The amount of force needed to free a stuck pallet varied.

Cooler Control Room

A cooler control switch, in the control room, allowed the cooler system to be switched from automatic to manual control.

The unit 4 digital control system (DCS) log for November 6, 2005, from 11:40 a.m. to 12:30 p.m., indicated the control room operator received the stuck cooler pallet alarm at 11:44:37 and acknowledged the alarm at 11:44:48. The control room operator then switched the cooler control from automatic to manual control at 11:44:54.

The control room operator gave 22 cooler drive manual start commands between 11:45:37 and 11:49:05. When the cooler didn't start after a command was given, a 5 second delay occurred until the cooler alarm sounded again. The DCS log indicated that the unit 4 cooler started up at 11:49:05 and that a stop cooler command was given at 11:49:13.

Pallet Repairs

Unit 4 cooler was down for a maintenance outage from October 31, 2005, until the afternoon of November 5, 2005. During the outage, ½ inch X ½ inch pieces of key stock were welded at the interface of moving pallets 1, 2, and 13 through 30, and the stationary cooler walls (see picture #7). The repairs included pallet 27, involved in the incident, and were considered a normal maintenance repair for any major or minor outage. The key stock material added to the edges helped prevent spillage of pellets from the pallets. Unit 4 was re-started at 7:20 p.m. on November 5, 2005.

Miners interviewed indicated that, until the cooler reached its normal operating temperature, the pallets were more likely to stick. During the initial heat up and run in period, clearances were established by temperature and "wearing in". Consequently, pallets did become stuck after repairs due to heating and expansion of metal components.

Rotational Forces on the Pallet

The weight of the pallet exerted approximately 5,300 foot pounds of torque on the pallet shaft in a counter-clockwise direction when facing the dump arm.

The weight of the pellets exerted approximately 11,400 foot pounds of torque on the pallet shaft in a counter-clockwise direction when facing the dump arm.

At the time of the accident, the pallet trip mechanism exerted approximately 7,600 foot pounds of torque on the pallet shaft in a counter-clockwise direction when facing the dump arm.

The dump arm and wheel exerted approximately 800 foot pounds of torque on the pallet shaft in a clockwise direction when facing the dump arm.

The net effect of the forces at the pallet shaft was approximately 23,500 foot pounds of torque on the pallet shaft in a counter-clockwise direction when facing the dump arm.

Weather Conditions

Weather was not considered a factor in the accident since it occurred inside the unit 4 cooler.

Medical Analysis and Findings

A sample of the victim's blood was analyzed for alcohol and controlled substances by an independent forensic laboratory. The active form of Cannabinoid was determined to be 8 nanograms/ML. No independent observations of the victim's behavior could support that he was impaired due to the drug.

Training and Experience

Chad M. Weston had one year and two months mining experience, all at this mine. He had received training in accordance with 30 CFR, Part 48 and had received task training for stuck cooler pallets. Weston had conducted the task six times prior to the accident.

ROOT CAUSE ANALYSIS

An analysis was conducted and the following root cause was identified:

Root Cause: Management procedures and controls were inadequate and did not ensure that persons were protected from the sudden movement of equipment while releasing stuck cooler pallets.

Corrective Action: Procedures should be developed and implemented that ensure persons assigned to manually release the dump arm are protected from movement of the dump arm when a stuck cooler pallet is freed.

CONCLUSION

The accident occurred because the operating procedures and controls used to release the stuck cooler pallet were inadequate. The procedures in place did not ensure that persons were protected from being struck by the sudden movement of the pallet dump arm while performing this task.

ENFORCEMENT ACTIONS

Order No. 6187661 was issued on November 6, 2005, under the provisions of Section 103(k) of the Mine Act:

> A fatal accident occurred at this operation on November 6, 2005, when a miner was attempting to free a stuck pallet on the inside of unit 4 cooler's dump point. This order is to assure the safety of all persons at this operation until an examination or investigation is made to determine that the inside of unit 4 cooler dump point area is safe. Only those persons selected from the company officials, state officials, the miners' representative, and other persons who are deemed by MSHA to have information relevant to the investigation, may enter or remain in the affected area.

This order was terminated on November 10, 2005. Conditions that contributed to the accident no longer exist.

Citation No. 6175971 was issued on January 30, 2006, under the provisions of Section 104(a) of the Mine Act for a violation of 30 CFR 56.14107(a):

> A fatal accident occurred at this mine on November 6, 2005, when an assistant plant operator was struck by a cooler dump arm. The victim and his co-worker were attempting to free a stuck cooler pallet when the pallet broke free, the dump arm moved suddenly and pinned the victim against the cooler framework. A guard was not provided at the cooler pallet dump arm release area to protect persons against the sudden movement of the cooler pallet dump arm upon release from the stuck position.

This citation was terminated on January 30, 2006. A guard was installed at unit 4 to prevent access to the cooler pallet dump arm. New policies and procedures were implemented to ensure that persons are protected from movement of the dump arm. Retraining was provided to miners working with the system.

Approved by: Date:

Steven M. Richetta
District Manager
North Central District

APPENDIX A

Persons Participating in the Investigation

Empire Iron Mining Partnership

Leonard R. Parker	manager-safety and environment
John Kosher	operations manager-CCI
Jim R. Hallesy	senior reliability engineer
Todd E. Davis	senior section manager-pellet plant operations
E. Kimball Alvey	senior section manager-safety loss control-CCI

USWA, Local 4950

John E. Parent	president
Richard R. Ryberg	safety chairman
Larry M. Marta	safety representative

Jackson Kelly, Attorneys at Law

R. Henry Moore	attorney

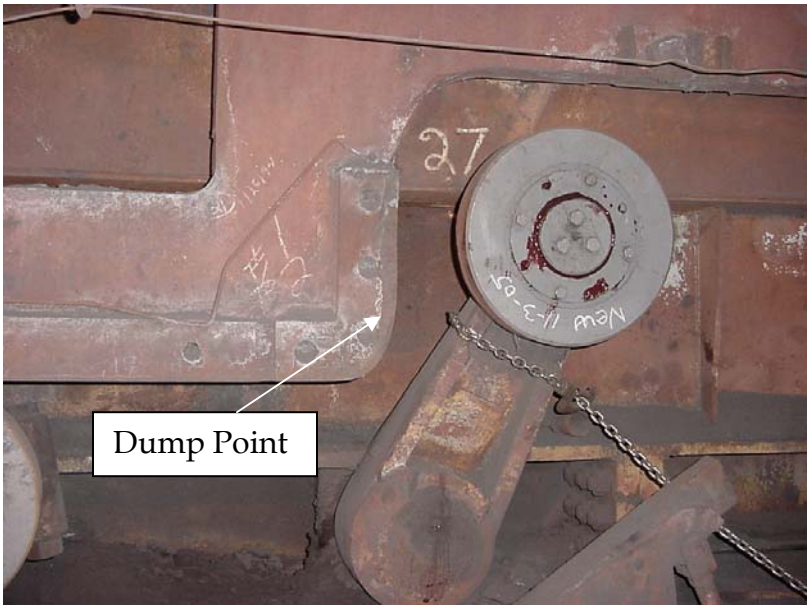
Mine Safety and Health Administration

William G. Dethloff III	mine safety and health inspector
Robert W. Leppanen	mine safety and health inspector
Dale P. Ingold, PE	general engineer

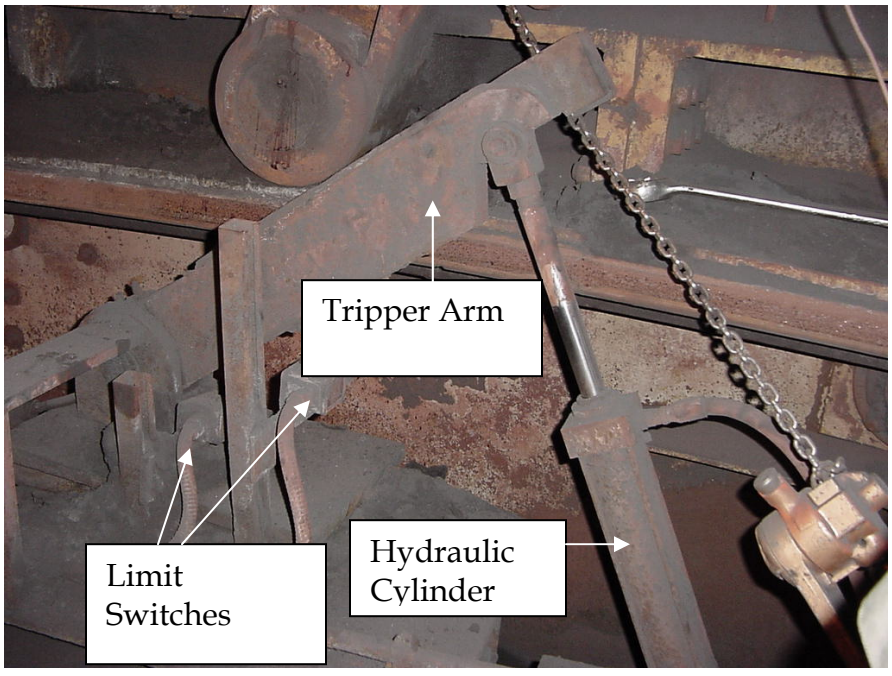
APPENDIX B

Picture #1

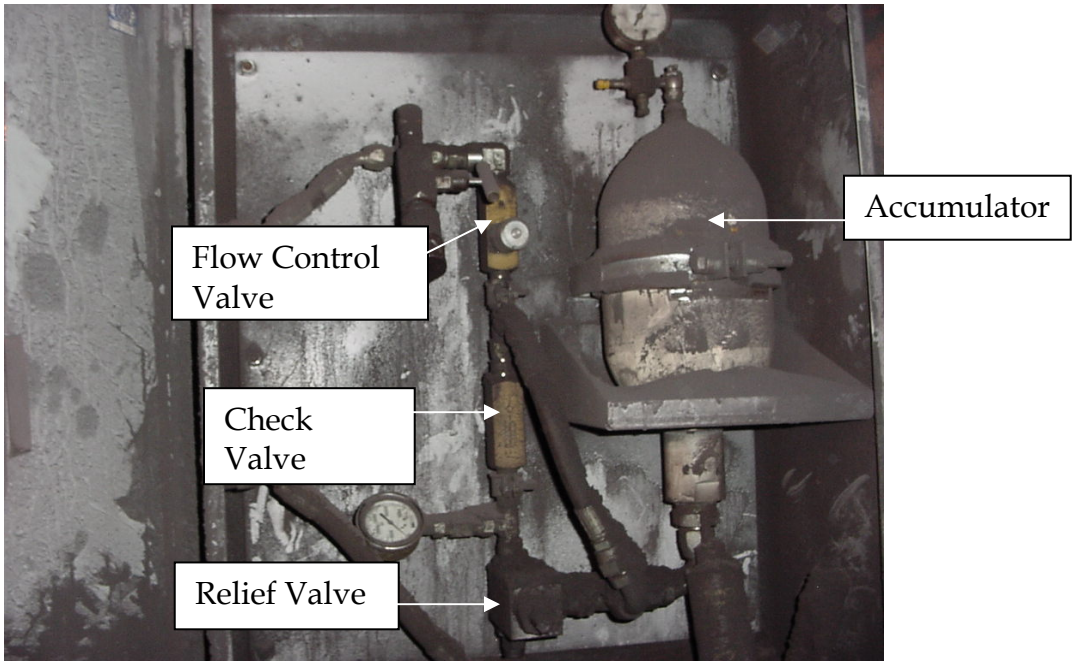
Demonstration of placing port-a-power cylinder under a stuck cooler pallet dump arm.



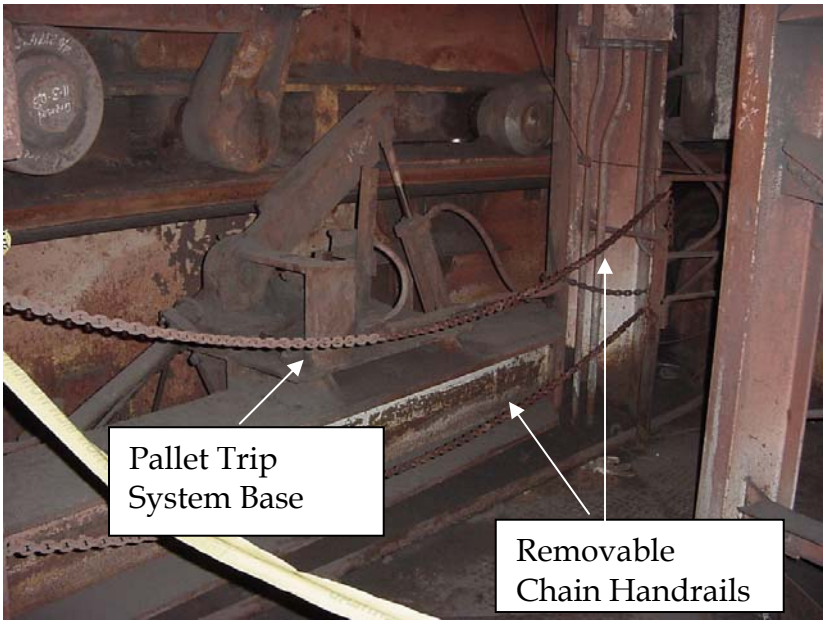
Picture #2



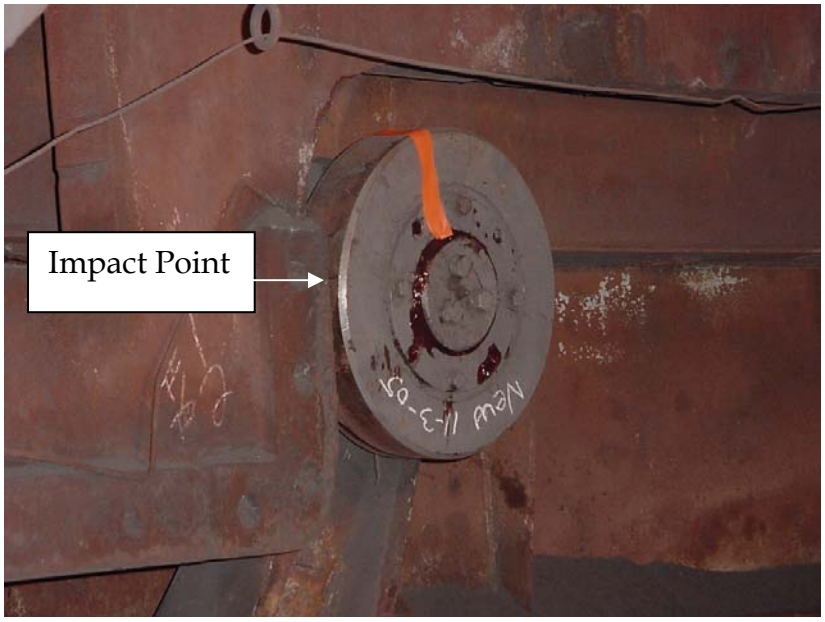
Picture #3



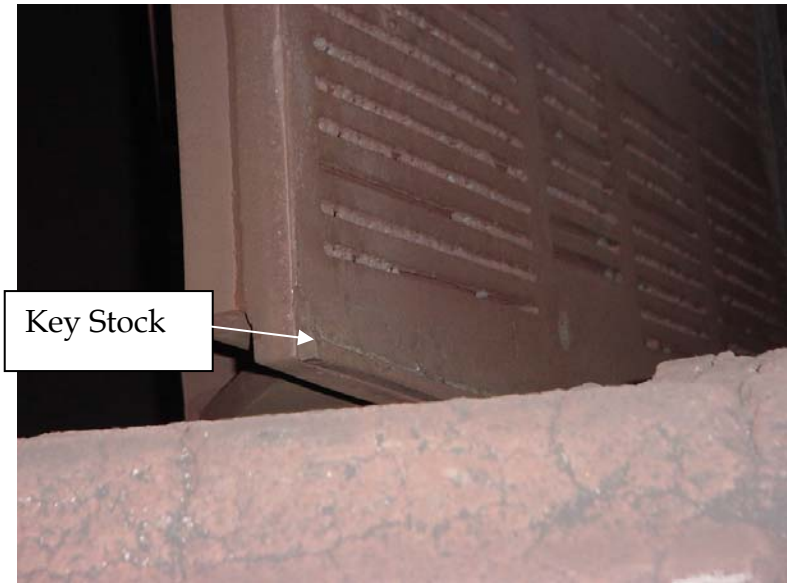
Picture #4



Picture #5

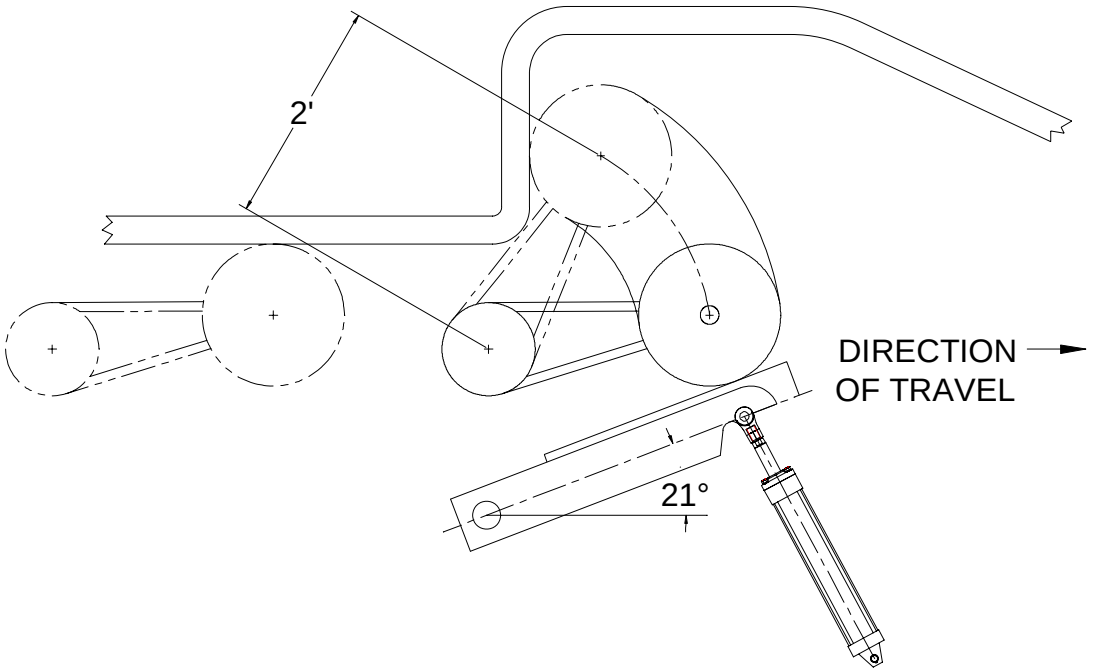


Picture #6



Picture #7

APPENDIX C



U.S. Department of Labor MSHA Mine Safety and Health Administration	PROJECT: EMPIRE MINE FATALITY; NOVEMBER 6, 2005		
	SUBJECT: SKETCH OF UNGUARDED WHEEL TRAVEL AREA		
DATE: 12/5/2005	DWG NO.: 91938-001		REV: 0
DWG SIZE: B	SCALE: NTS	SHUMAKER	SHEET: 1 OF 1